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DIVISION OF FORESTRY.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF FORESTRY,
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The following statement, prepared by Mr. Filibert Roth, of this Division, represents in condensed form the results of tests and investigations made on the Bald Cypress, one of the important timber trees of the Southern States, as part of the timber physics work of the Division of Forestry. The tests were made, as were those reported heretofore, in the laboratory at St. Louis, under Prof. J. B. Johnson, on test material collected by Dr. Charles A. Mohr. The physical examinations were carried on by Mr. Roth, who also made an inspection of the field upon which the notes regarding the nature and extent of Cypress supplies are based. The assistance of mill men, timber-land owners, and many other persons who facilitated Mr. Roth's inspection of the field and made it most profitable is hereby publicly acknowledged.

Besides furnishing data of the physical and mechanical properties of this class of timber, the results recorded in this circular also confirm or advance further the statements of the relation of physical and mechanical properties of wood in general previously established by this Division.

With this publication this work in timber physics will probably be brought to a close, since it has been decided to abandon the same as part of the work of the Division of Forestry.

B. E. FERNOW,
Chief of Division.

Approved:
JAMES WILSON,
Secretary of Agriculture.

PROGRESS IN TIMBER PHYSICS.

BALD CYPRESS (Taxodium distichum).

NAME.

The name Bald Cypress, which expresses the fact that the tree in winter time loses its foliage, in which it differs from most other conifers, is usually shortened both in the field and market by dropping the adjective. The names "White," "Yellow," "Black," and "Red" Cypress are frequently used to designate distinction in quality of the wood. These names, having been used for advertising purposes, have led to much confusion and to the assumption of differences which only in part exist.

The terms "Black Cypress" and "White Cypress" appear to have arisen in Virginia and the Carolinas, and Black Cypress denoted originally Cypress timber which would not float and White Cypress that which would float. In this sense the terms are still used by many of the woodsmen and shingle makers, and even the men about the sawmills are by no means agreed as to what they mean by the two terms, most of them to this day making the distinction chiefly one of weight, though in all cases deeply stained lumber is at once pronounced "black."

In Louisiana the term "Red Cypress" is used to mean very much the same thing, except that it refers much more generally to a color distinction. To anyone who has examined a number of fresh logs, and especially a lot of fresh stumps in that State the origin of the word is quite plain. On the fresh stump a well-marked rather deep reddish color is conspicuous, and even in the lumber piles a general roseate hue, as distinct from the more common olive brown seen on the Atlantic coast, is quite apparent. The same color appears not only in Louisiana, but also in Florida. Nevertheless, it is not this light roseate hue which makes the Red Cypress of Louisiana. Material of this hue is dealt with as ordinary lumber. The "Red Cypress" of the lumber yard comprises only the deeply stained boards, which here, as everywhere, are the exception. They form not more than 4 to 6 per cent of the cut and are, as to position in log and tree and also as to probable causes, identical with the Black Cypress of the Atlantic. It is interesting to note, however, that even in these dark-stained boards the reddish hue is still quite conspicuous in Louisiana yards, and that some very pretty deep shades, with tints of plum color, are frequently seen.

RANGE AND MANNER OF OCCURRENCE.

As a tree of economic importance the Cypress occurs along the coast of the Atlantic and Gulf from Maryland to Texas, and in the Mississippi Valley as far north as the juncture of the Mississippi and Ohio rivers. Over 90 per cent of the Cypress is located at an elevation of less than 100 feet above sea level, and large bodies of merchantable Cypress never occur at elevations above 500 feet; in fact, only along some of the rivers, particularly the Mississippi and its tributaries, does it rise to an altitude of over 250 feet. Throughout this range it occupies parts of all swamps, appears in nearly all river and creek bottoms, spreads over the deltas of the larger streams, and occupies the shallow, wet depressions known as Cypress ponds, so common in the sandy pinery districts of the South. It forms extensive forests in the delta of the Mississippi, where it covers several thousand square miles, and also in some of the large swamps of Florida and Georgia, such as the Okefenokee and the great Cypress swamps fringing the Everglades. It also occurs in extensive and almost pure bodies along most of the rivers of Florida and forms the predominant part of the dense forests of the fertile bottoms of all the larger rivers of the South below an altitude of 100 feet.

From the nature of its station it follows that the Cypress forest is never encroached upon by pine. It grows, however, usually in mixture with a variety of broad-leafed trees, although tracts of several hundred acres are not infrequent upon which it occurs in pure or almost pure growth.

CHARACTER OF GROWTH AND AGE.

On all fertile lands the Cypress attains large dimensions, commonly a height of over 100 feet and a diameter of over 4 feet above the swell or "bottle" butt. This is true in all parts of its range. Large trees have been cut in Maryland and large timber still exists in Virginia and North Carolina, while the Cypress of the river bottoms of South Carolina and Georgia equals, if it does not excel, in its dimensions the Cypress of any other locality. The largest tree seen by the writer measured 10½ feet at 3 feet from the ground and was about 120 feet in height. The usual dimensions of logs as brought to the mill, according to an extended tally at one of the mills, which represents a fair average, show the diameters to vary between 22 and 25½ inches, occasionally going as high as 28 inches, at the small end.

In a run of 6,518 logs the average scale, as per Doyle rule, was 267 feet B. M. per log, the cut being slightly larger; in another run of 2,769 logs the scale was 345 feet B. M., while the actual mill product, including shingles and laths, was only 332 feet B. M.

Generally Cypress cuts very wastefully; 15 to 20 per cent is assumed even after the logs are in the raft, so that from the entire stem there is never less than 20 to 25 per cent of waste.

On poor soils, as in the pine-barren ponds, the Cypress remains much smaller, both in height and diameter, and is generally too small for saw timber, and is therefore used, if at all, for telegraph poles, piling, ties, etc. Along the banks of lakes and rivers many of the specimens remain exceedingly stunted, develop enormous (usually hollow) bases, often accompanied by an excessive number of conspicuous knees. Trees of this kind are common, often not over 20 feet in

height, with a diameter of 10 to 12 inches a few feet above the swelled base, which latter often attains 10 feet in diamter.

The rate of growth of Cypress is fairly good in height; trees 80 to 90 years old on good soil have a height of 70 to 80 feet, and the "leaders" of this year (1897), on specimens grown on good bottom lands, measured from 10 to 18 inches. The growth in diameter is generally slow in all parts of its range. Leaving out the bottle butt, the tree generally requires from 10 to 15 years, frequently 15 to 25 years, to add 1 inch of wood to its diameter. The growth is but little faster when the tree is young, and is kept up at a remarkably even pace to great age, trees 900 to 1,200 years continuing to lay on wood as fast during the last century as in former times. (See Table I.)

From these measurements it is apparent that on account of its slow growth in its natural habitat Cypress is not likely to reproduce the large amounts of timber annually cut, and that even if the rich bottoms should remain forests the supplies will sooner or later be cut out. What judicious handling of the forests could do will require further study. From the very limited experience it would seem that Cypress is not necessarily slow in its growth; trees on the rather poor soil in Washington, D. C., have grown one-half to 1 inch per year in diameter, and similar growth has been made by the trees planted in the Shaw Gardens, St. Louis, which, though less than 50 years old, are 60 to 70 feet high and 14 to 18 inches in diameter.

Most of the trees now cut for the mills are large and old remnants of former forests; they can hardly be called mature, for they seem far past the average life even of Cypress. A tree over 1,200 years old was examined on the Santee River, and trees over 500 years of age were seen in every locality visited. The average age of the Cypress exploited at present may safely be set above 300 years. Where this timber is mixed with younger growth (the "buck" Cypress of the South Carolina woodsmen) the great age, or overripe condition, is most apparent. Thrifty, shapely Cypress trees 2 to 3 feet in diameter may here be seen with long pyramidal crowns, which sharply contrast with the old timber trees 5 to 8 feet in diameter, with short, flat, usually mutilated crowns on a thick, stubby trunk.

Though generally of fine dimensions, Cypress is not really long-shafted; generally it is 3½ to 4 log timber, and cuts only 2½ to 3 logs in most parts of the St. Johns and other rivers of Florida, as well as in many of the swamp forests of that State. This is in part due to the form of the crown, which suddenly terminates the stem, allowing of no "top" logs, but is also due to the prevalence of a defect known as "pegginess," "peck," or "botty," which seems almost normal to this species.

Aside from the swelled butt, which is common to Cypress in all localities, the taper of the trees is not great, and often not greater than in pines. From a number of measurements butt logs were found to taper about 6 inches in 30 feet, leaving out of consideration the first 6 feet of swell butt, and about 4 inches in 30 feet for top logs.

In telegraph poles 8 inches at the top and 40 feet long the taper averages about 2 inches per 10 feet. Such "young" trees are from 100 to 140 years old, while of trees 75 to 90 years old, with diameters of 6 to 9 inches at 6 feet from the ground, sprung up on an abandoned rice field, one was found to taper from a diameter of 8 inches at 6 feet to 3 inches at 66 feet, or less than 1 inch per 10 feet.

THE DISEASE KNOWN AS "PEGGINESS."

The common defect, the "pegginess," "peck," "puck," or "botty,"* is due to a fungus, which usually begins its work at some broken stub of a limb and works downward. The cross section of a "peggy" log looks as if a number of small pegs, one-fourth to 1 inch thick, had been driven into the log, then withdrawn, and the holes filled with powdered, decayed wood. Young trees are generally free from this trouble, and in no case was it seen in trees except where part of the crown had been broken. The total damage due to this disease is probably not less than 30 per cent of the entire Cypress supply. There is no region spared by this defect; it exists in all localities, in every bottom, swamp, and pond; but here and there places are especially infested.

*The word "botty" is used in North Carolina, and is based on a belief that the trouble is due to a beetle larva, here termed "bot," but most woodsmen fully realize that this belief is a mistake.

A body of Cypress in Florida had to be abandoned entirely on account of the prevalence of "pegginess." Sometimes trees 3 to 5 feet in diameter are sound at the butt, and for 10 to 15 feet up, and are so badly damaged the rest of their length as to be entirely useless. Nor is it possible usually to tell peggy from sound trees. Contrary to a common belief, this decay due to pegginess does not spread after the piece is converted into lumber. A plank of peggy cypress in an old sidewalk, though often grooved and hollowed by the "peg" holes, is perfectly sound, the soft decayed wood having been washed out, leaving the holes and grooves like so many clean auger holes. Not a single case of spreading of this trouble was seen or reported, while many pieces were seen which had been in use for many years in exposed positions, and, though badly worn, were as sound as ever. As to ultimate causes of "pegginess," its association to knees, etc., nothing is known at present.

Occasionally Cypress is hollow-butted, but this is not generally a serious defect and leads to no more waste than do the swell butts in themselves, which at all times tempt to high cutting, whereby a large amount of choice material is left in the woods. In this connection it is of interest to note that the knees, such a conspicuous feature in the Cypress forest, are very unequally distributed and developed. The most remarkable development in number and size has been observed in small crippled trees along the banks of lakes and streams, while some of the largest timber is often almost entirely without knees. The presence or absence of water seems equally unimportant for this development, since comparatively few knees are seen in parts of the Okefenokee, where the ground is constantly covered by water, while large and abundant knees may be seen on the ordinary river swamps, where the ground is overflowed not more than one-tenth part of the year. The assumption of a relation between the formation of knees and quality or growth of timber is without foundation.

SUPPLIES.

The yield per acre is naturally variable; yields of 75,000 to 100,000 feet B. M. per acre are not rare in the dense Cypress forests of Louisiana, and equally large yields are met with occasionally on small tracts of the eastern river bottoms. Generally, however, the yields are far smaller, and even for the Louisiana forests an average of only about 15,000 feet B. M. per acre is claimed, while for the river bottoms, such as the Altamaha, where so much ground is occupied by other timber than Cypress, the average yield is probably not over 2,000 feet B. M. per acre. This variability of yield, together with the great difficulty of ascertaining the area stocked with Cypress, being for the most part in irregular narrow belts along the rivers and in imperfectly surveyed swamps, render a general estimate of Cypress supplies very difficult and unsatisfactory.

One of the best authorities on this subject places the supplies of Cypress saw timber at about 27,000,000,000 feet B. M. distributed as follows:

	Feet B. M.		Feet B. M.
Louisiana	12,000,000,000	Georgia	2,500,000,000
Florida	5,000,000,000	North Carolina	1,000,000,000
Alabama	500,000,000	Arkansas	2,000,000,000
South Carolina	3,000,000,000	Mississippi*	1,000,000,000

Though probably as nearly correct, for present methods of exploitation, as can be had, the above estimate is still believed to be somewhat conservative, probably by as much as 30 per cent, if the smaller timber so far left untouched in many places is added.

The total cut of Cypress is estimated at about 500,000,000 feet B. M. a year, of which the greater part is cut in Louisiana, where, within a radius of about 120 miles around New Orleans, mills with an aggregate daily capacity of over 750,000 feet B. M. are manufacturing Cypress. Other important points of output are Mobile, Ala., Apalachicola, Pensacola, and Palatka, Fla., Brunswick, Ga., Georgetown, S. C., and Wilmington and Waccamaw, N. C., besides a number of points in the Mississippi Valley. The bulk of Cypress is cut into boards and planks, a great deal also into long lengths for special purposes, greenhouse frames, gutters, etc., and in most mills the

*This estimate for Mississippi is seriously questioned by some well-informed men; the State is credited by some as having possibly near eight billion feet of standing Cypress, the bulk of which is located along the Yazoo and other branches of the great river system.

curly forms and boards of darker colors and pleasing patterns are kept separate, and in the future even a greater selection may be expected in this direction, since the unusual beauty of Cypress for panelings, fancy doors, etc., is just beginning to be recognized. In all mills shingles and laths are made of the heavy slabs, and in a few mills the entire log is converted into shingles, for which this wood is specially suited.

METHODS OF EXPLOITATION.

In logging operations the trees are generally girdled (though not universally) the season before felling, to permit the tree to season on the stump. This process appears to be of doubtful value, in so far as it adds but little to the floating capacity (in itself unimportant except where logging is done on rivers) and endangers the timber. If girdling is done in the spring and summer, or even in the early fall, insects, particularly the large bark beetles, producing the large flat larva (worm) and a host of small beetles, at once begin their work. Generally these do no further damage than to gnaw the inner bark and channel the surface of the wood, loosening thereby the bark, but in some cases these comparatively harmless forms are accompanied by a regular wood borer of the Ambrosia beetle group, which bores straight into the wood and invariably produces a sharply marked black stain, which calls attention to the small hole made by the borer. So far these borers have done little damage, but their depredations may become serious at any time. When a large tree is girdled in the summer, standing, as it does, in a dense, humid forest, and losing its foliage soon after the operation, the amount of drying is probably small and the consequent benefit insignificant.

Owing to the inaccessibility of the ground the use of teams is practically unknown in cypress logging. Along the rivers in the Carolinas, Georgia, and Alabama the trees are cut and sawed into long lengths (20 to 40 feet) and left there until a flood or "freshet" enables the raftsmen to push the log into an opening or "road," where it is joined to others and driven to the river, fastened into rafts, and rafted to the mill. In the Okefenokee a canal is dredged into the forest, and the logs are at once dragged into deep water by a "steam skidder,"* rafted, and drawn to the mill with a canal steamboat. On the St. John and Oklawaha, and also in the swamps of parts of Florida and Louisiana, large pull boats, as well as skidders, are employed, which draw the logs from the place where they fall, a distance of 2,000 feet and more, to a river or railway, where they are loaded or rafted. The enormous weight of the timber, usually in lengths greater than 20 feet, requires unusual machinery.

CHARACTER OF THE WOOD.

The wood of this species was studied in the forests, at mills, and in the laboratory. The material for the laboratory studies consisted of a collection of specimens from 39 trees collected in the principal localities, besides other material obtained at mills.

The collection embraced—

(*a*) "Pond Cypress" from pine barrens of South Carolina.
(*b*) "White Cypress" of Savannah River bottoms.
(*c*) "Red Cypress" from St. Marys Parish, La.
(*d*) "White Cypress" from Mississippi bottom, Percy, Miss.
(*e*) "Upland Cypress," Poters Bayou, Mississippi.

Cypress is a typical coniferous wood of dark color, of medium weight and strength, great durability, fine and even grain (narrow rings), fairly long fiber, without resin ducts but with resin cells, somewhat slow to dry but easily worked, and well suited to as great a number of uses as any other wood of our markets.

The sap and heart wood are quite distinct; the former is from one-half to 4 inches, generally 1 to 2 inches wide, and of a slightly lighter color than the latter. As in the cases of pine, the sapwood is more narrow in slow-growing timber, but in keeping with the steady growth; its width is more independent of age. On a smooth cross section the rings are quite distinct; the summer wood, whether narrow or wide, is always quite sharply defined against the spring wood of the following ring. Occasionally the resin cells, which are commonly arranged in broken, indistinct concentric lines, become sufficiently conspicuous to appear as separate lines, and thus mislead as

*Of the Lidgerwood system.

to the number of rings. The wood is of a simple structure, 80 to 90 per cent is formed by the ordinary fibers or tracheids resembling those of other conifers, and in cypress about 4 mm. (one-sixth of an inch) long with a diameter of 40μ to 50μ in spring and 20μ to 30μ in summer wood.

The color of cypress is generally a yellowish, grayish brown, lighter in the sap than heart, and commonly mixed with darker shades of olive brown or shades of reddish or roseate brown. In young sound timber no striking color differences are observed; the heavier timber has a greater percentage of dark-colored lines or bands of summer wood, and considerable individual differences also occur. In all old timber, however, the matter is quite different. At every cypress mill logs may be seen where the end faces appear as in fig. 1; the heart is of a rather uniform dark grayish brown, but there are one or more concentric, often imperfect, deeply stained dark-colored zones which, when the log is opened, reveal themselves as hollow cylinders, appearing on the boards as broad dark stripes, running often the entire length of the board, and if this be a good bastard cut, as at *a* in fig. 1, often involving the entire board and thus producing a typical piece of "Black Cypress," if on the Atlantic border, or of "Red Cypress," if in Louisiana. These extensive stains are not rare; they occur in all localities, and often more than 25 per cent of all logs in a pond show them, but the real deeply stained boards are much less common, since they depend on width of stain and position of cut; they never form a heavy percentage, probably never over 6 per cent at any mill. The cause of these stains has not been fully worked out as yet. This, however, seems certain:

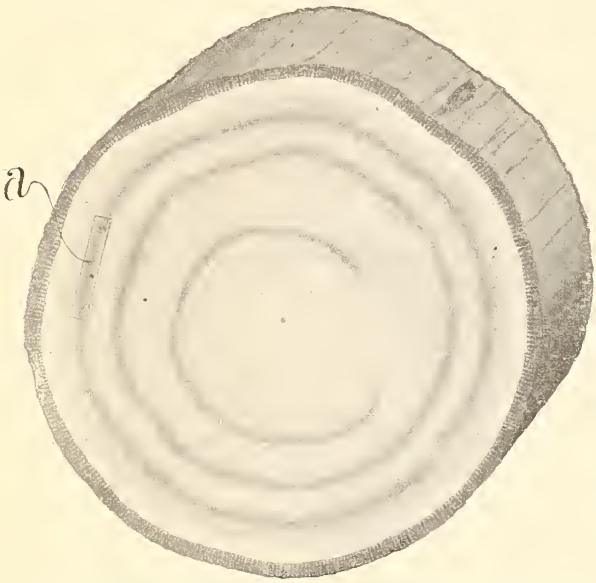

FIG. 1.—Cross-section of Cypress log showing dark-colored zones.

(*a*) They do not occur in young sound timber.
(*b*) They are always present in old defective timber injured by fungi;
(*c*) They increase in amount and depth of color with amount of defect, and
(*d*) They are independent of the weight and strength of wood, and, as far as is known at present,
(*e*) Have nothing to do with the general durability of the material.

PHYSICAL PROPERTIES.

WEIGHT.

The summer wood, with its greatly thickened walls, naturally is much heavier than the spring wood. From direct measurements of the cell walls, the specific gravity of which is 1.50, as well as from a comparison of different pieces having a varying percentage of summer wood, it was found that the summer wood has a specific gravity of about 0.90 and the spring wood of about 0.36.

The relative proportion of the summer wood is thus a direct indication of the weight, and with this, of the strength of the wood, and is so utilized in Table 1, in which the density corresponding to a given summer-wood percentage is given in addition to the summer-wood percentage itself. To prevent undue length of table the results for ten rings or ten years' growth are always represented by one figure; the measurements are in millimeters (one twenty-fifth of an inch).

TABLE I.—*Specific weight of Cypress, showing also rate of growth in diameter and weight of wood of different ages.*

[Calculated from summer wood, per cent.]

Rings, in groups of 10, beginning at bark.	No. of tree and disk. Tree 321, Disk I. Width of rings in groups of 10 rings.	Tree 321, Disk I. Summer wood, per cent.	Tree 321, Disk I. Specific weight × 100 (calculated).	Tree 5 (A), Disk IS. Width of rings in groups of 10 rings.	Tree 5 (A), Disk IS. Summer wood, per cent.	Tree 5 (A), Disk IS. Specific weight × 100 (calculated).	Tree 324, Disk II. Width of rings in groups of 10 rings.	Tree 324, Disk II. Summer wood, per cent.	Tree 324, Disk II. Specific weight × 100 (calculated).	Tree 344, Disk I. Width of rings in groups of 10 rings.	Tree 344, Disk I. Summer wood, per cent.	Tree 344, Disk I. Specific weight × 100 (calculated).	Tree 346, Disk I. Width of rings in groups of 10 rings.	Tree 346, Disk I. Summer wood, per cent.	Tree 346, Disk I. Specific weight × 100 (calculated).
	mm.			*mm.*			*mm.*			*mm.*			*mm.*		
1- 10	22.2	13	43	11.8	0.9	36	12.9	24.5	49	12.2	18	46	6	13	43
11- 20	26.3	9.5	41	17	6	39	10.2	20	47	12.2	23	49	5.4	16	44
21- 30	33.4	5	39	5	19	46	17.2	20.5	47	16.9	16.6	45	5.9	19	46
31- 40	46.2	6.4	39	24	5.5	39	15.4	23	49	12	20	47	4.5	35	55
41- 50	55.7	2.9	37	38	2.1	37	15.3	23.5	49	14	22	48	4.8	24	49
51- 60	85.1	1.1	36	(17)	(3.6)	(38)	12.1	28	51	6.4	17.5	45	4.2	20	47
61- 70	67.9	2.2	37	......	......	......	9.2	29	52	12.3	20	47	4.7	20	47
71- 80	(13.6)	(0.5)	(36)	......	......	......	13.3	23	49	13.7	14	44	5.6	20	47
81- 90	......	......	......	......	......	......	23.7	27.5	51	22.5	14	44	5.5	15	44
91-100	......	......	......	......	......	......	26.5	22	48	17.6	18	46	15.2	7.5	40
101-110	......	......	......	......	......	......	26	25	50	21.5	18	46	13.2	21	47
111-120	......	......	......	......	......	......	27.3	23	49	26.1	14	44	13.6	13	43
121-130	......	......	......	......	......	......	20.4	23	49	24.2	8	40	20.2	7	39
131-140	......	......	......	......	......	......	11.3	25	50	25.3	4.1	38	19.4	11	42
141-150	......	......	......	......	......	......	(6.4)	(21)	(47)	......	......	......	26.1	6	39
151-160	......	......	......	......	......	......	......	......	......	......	......	......	(6.4)	(4.7)	(38)
Calculated specific weight	......	4.0	38	......	2.6	37	......	24	49	......	15	44	......	12.7	43
Observed specific weight of adjoining piece	......	......	39	......	......	38	......	......	48	......	......	45	......	......	44

NOTE.—Figures in parentheses refer to groups of rings less than 10.

TABLE I.—*Specific weight of Cypress, showing also rate of growth in diameter and weight of wood of different ages*—Cont'd.

[Calculated from summer wood, per cent.]

Rings, in groups of 10, beginning at bark.	No. of tree and disk.														
	Tree 353, Disk I n.			Tree 355, Disk II n.			Tree 455, Disk II S.			Tree 354, Disk II S.			Tree 456, Disk II.		
	Width of rings in groups of 10 rings.	Summer wood, per cent.	Specific weight × 100 (calculated).	Width of rings in groups of 10 rings.	Summer wood, per cent.	Specific weight × 100 (calculated).	Width of rings in groups of 10 rings.	Summer wood, per cent.	Specific weight × 100 (calculated).	Width of rings in groups of 10 rings.	Summer wood, per cent.	Specific weight × 100 (calculated).	Width of rings in groups of 10 rings.	Summer wood, per cent.	Specific weight + 100 (calculated).
	mm.			*mm.*			*mm.*			*mm.*			*mm.*		
1– 10	12.6	20	47	9.6	41	58	5.3	29	52	2	31.5	53	8.1	59	68
11– 20	11	24	49	11.2	44	60	8	20.5	47	1.5	26.6	50	5.6	37	56
21– 30	8.2	21	47	5.7	30	52	8	20.6	47	2.1	38	57	4.5	29	52
31– 40	6.8	15	44	4.6	33	54	5.6	25	50	2.5	38	57	5.1	33	54
41– 50	4	24	49	4.1	38.5	57	9.1	27	51	1.6	38	57	5.8	31	53
51– 60	2.6	29	52	2.3	42	59	6	21	47	9.3	53	65	5.4	33	54
61– 70	7.8	16	45	6.4	40	58	6.4	26	50	17.5	63	70	5.2	31.5	53
71– 80	3.3	21	47	13.8	42	59	9.4	21	47	4.9	35.6	55	4.9	20.5	47
81– 90	4.6	22	48	8.3	36	55	4.5	27	51	12.9	47.7	62	2.5	31	53
91–100	4.5	23	49	9.1	39	57	6.3	21	47	8.3	53.4	65	6.4	47	61
101–110	4	24	49	11.6	41	58	7.5	21	47	6.4	38	57	9.6	32	53
111–120	5.3	22	48	6.8	44	60	8.6	22.5	48	7.7	53	65	4.8	50	63
121–130	11.1	22	48	12.1	38	57	9.3	24	49	10	47.6	61	8.7	61	69
131–140	6.4	22	48	6.9	28	51	6.3	36	55	9.6	42.2	59	4.4	33	34
141–150	11.8	28	51	9.3	32	53	9.9	27	51	12.3	46	61	8.8	52	64
151–160	12.1	16	45	8	36	55	7	30	52	13.5	44	60	12.3	50	63
161–170	6.6	19	46	9.7	28	51	10.8	29	52	10.2	35	55	5.6	29.5	52
171–180	21.1	7.7	40	4.4	29	52	18.5	40	58	15	28.3	51	4.2	24	49
181–190	18.6	8.2	40	3.6	26	50	13.3	36	55	11.9	44	60	5.4	23	49
191–200	28.5	6	39	5.1	34	54	12.5	31	53	17	46	61	3.9	21	47
201–210	39.7	3.4	38	5	42	59	18.8	36	55	11.2	35.6	55	9.1	40	58
211–220	(14.2)	(2.5)	(37)	5.8	26	50	21.1	26	50	12.1	22.8	48	6.5	28	51
221–230	......	......	......	5	37	56	23.4	35	55	12	16.1	45	9.6	35.5	55
231–240	......	......	......	4	31	53	27.6	31	53	14.4	19.9	47	9.6	46	61
241–250	......	......	......	5.3	25	50	11.8	38	57	12.4	11.2	42	7	42.5	59
251–260	......	......	......	6.2	43	59	14.3	41	58	20.4	6.9	39	9.3	21	47
261–270	......	......	......	6.8	35	55	13.9	36	55	(13.4)	(1.9)	(37)	16.9	36	55
271–280	......	......	......	12.6	20.6	47	12.6	43	59	......	......	......	33.2	11	42
281–290	......	......	......	(34.6)	(7.8)	(40)	13.1	38	57	......	......	......	(10.7)	(0.7)	(36)
291–300	......	......	......	......	......	......	21.1	11.6	42	......	......	......	......	......	......
301–310	......	......	......	......	......	......	(28.8)	(5.3)	(39)	......	......	......	......	......	......
Calculated specific weight	......	13.4	43	......	31.2	53	......	28.2	51	......	34.4	54	......	32.4	53
Observed specific weight of adjoining piece	......	......	43	......	......	53	......	......	......	......	......	49	......	......	49

NOTE.—Figures in parentheses refer to groups of rings less than 10.

TABLE I.—*Specific weight of Cypress, showing also rate of growth in diameter and weight of wood of different ages*—Cont'd.

[Calculated from summer wood, per cent.]

Rings, in groups of 10, beginning at bark.	No. of tree and disk. Tree 274, Disk II. Width of rings in groups of 10 rings.	Tree 274, Disk II. Summer wood, per cent.	Tree 274, Disk II. Specific weight × 100 (calculated).	Tree 275, Disk II. Width of rings in groups of 10 rings.	Tree 275, Disk II. Summer wood, per cent.	Tree 275, Disk II. Specific weight × 100 (calculated).	Tree 276, Disk I. Width of rings in groups of 10 rings.	Tree 276, Disk I. Summer wood, per cent.	Tree 276, Disk I. Specific weight × 100 (calculated).	Tree 277, Disk II. Width of rings in groups of 10 rings.	Tree 277, Disk II. Summer wood, per cent.	Tree 277, Disk II. Specific weight × 100 (calculated).	Tree 278, Disk I. Width of rings in groups of 10 rings.	Tree 278, Disk I. Summer wood, per cent.	Tree 278, Disk I. Specific weight × 100 (calculated).
	mm.			*mm.*			*mm.*			*mm.*			*mm.*		
1- 10	3	28	51	2.6	27	51	4.1	23.5	49	2.3	31	53	6.8	21	47
11- 20	6.3	18	46	3.1	19	46	6.4	34.7	55	5.5	29	52	6.3	21	47
21- 30	8.3	16.5	45	1.4	30	52	3.3	23	49	7.3	30	52	6.3	19	46
31- 40	4	17	45	3.3	23	49	5	25	50	3.8	28.5	51	5.9	18	46
41- 50	4.3	18	46	3.1	21	47	5.3	35	55	5	29.4	52	6	20	47
51- 60	4.2	20	47	5.8	22	48	6.8	27	51	6.8	32	53	8.2	16	45
61- 70	8.7	19	46	5.5	23	49	5.5	34	54	5.2	30	52	5.8	23	49
71- 80	6.2	23	49	5	27	51	6.6	23.5	49	6	30	52	6.2	24	49
81- 90	3.2	23	49	5.4	22	48	4.3	24	49	8.2	37	56	5.9	20	47
91-100	4.8	26	50	2.8	25	50	3.1	30	52	6.4	41	58	10.5	21	47
101-110	9.6	25	50	6.5	22	48	5.3	22	48	7.6	39	57	8.9	21	47
111-120	6.5	22	48	5.6	27	51	4.1	29.5	52	6	39	57	5.9	26	50
121-130	2.7	27	51	4	36	56	4.1	27.5	50	6.6	46	61	7.9	30	52
131-140	8.3	26.5	50	5.6	39	57	3.1	27	50	4.3	41	58	9.4	30	52
141-150	6.3	23	49	5.6	34	54	4.8	28	51	9.5	41	58	7	46	61
151-160	4.7	26	50	4.6	39	57	4.4	41	60	8.1	35.5	55	11.2	31	53
161-170	8.7	18	46	7.2	34	54	5	31	53	9.9	38	57	9.2	36	55
171-180	13.7	22	48	4.2	32	53	4	45	60	7	38	57	11.6	38	57
181-190	7.4	23	49	4.2	40	58	4.2	39	57	5.9	40	58	12.5	32	53
191-200	8.8	23	49	3	47	61	4.6	44	58	5.2	53	65	11.8	21	47
201-210	4	19	46	4.5	33	54	8	36	55	6.1	43	59	8.3	35	55
211-220	4.8	22.5	48	5	26	50	5.2	48	62	6.9	51	64	6.6	38	57
221-230	5.2	27	51	6.8	29	52	4.6	39	57	4.2	50.5	64	10	22	49
231-240	5.5	22	48	5.1	27	51	5.7	37	56	8.2	48	62	13.4	18	46
241-250	4.1	19.5	46	6.6	31	53	5	36.5	56	6.2	41	58	8.2	18	46
251-260	10	15	44	7.1	36	56	6.5	29	52	12.1	62	70	7.8	23	49
261-270	12.9	14	44	6.6	22	48	10	39	57	12	50	63	(7.4)	(12)	(43)
271-280	11.6	11	42	12.5	9	41	8.8	39	57	7.2	33	54	......	......	......
281-290	10.4	17	45	(1.3)	(5.3)	(39)	10.5	36.5	56	3.9	31	53	......	......	......
291-300	16.9	6	39	......	......	......	13.4	18.5	46	3.8	34	54	......	......	......
301-310	(2.3)	(4)	(38)	......	......	......	(13.4)	(2.4)	(37)	5.6	50	63	......	......	......
311-320	......	......	......	......	......	......	......	......	......	*2.8	*46	*61	......	......	......
Summer wood, per cent, and calculated specific weight × 100	......	18	46	......	27	51	......	30	52	......	39	57	......	25.5	50
Observed specific weight of adjoining piece	......	......	43	......	......	51	......	......	52	......	......	62	......	......	53

NOTE.—Figures in parentheses refer to groups of rings less than 10.

* The records for this disk continue as follows:

	Rings of group. 321-330.	331-340.	341-350.	351-360.	361-370.	371-380.	381-390.	391-400.	401-410.	411-420.
Width of rings in groups of 10	2.6	2.6	2.1	2.3	2.8	2.7	2.9	4.1	5.1	(3.4)
Summer wood, per cent	43	36	31	31	31	32	36	34	23	(22)
Specific weight × 100	59	55	53	53	53	53	55	54	49	(48)

From the above table it appears that the summer-wood percentage, and with this the weight of the wood, varies from ring to ring or from decade to decade, but never in a regular manner, as is the case in pine, where the summer-wood percentage and weight are small in the young sapling, increase, and finally decrease, during the old age period. In Cypress both width of ring and weight of wood are seen to be quite independent of the age of the tree, and a uniformity of the timber is thus assured, such as is never seen in hard pine and occurs only in the uniformly light timber of White Pine.

The specific gravity of Cypress varies from about 0.35 to 0.60, and is for ordinary timber about 0.46, or 28½ pounds per cubic foot of dry wood. The weight varies within considerable limits, but without regularity in the same cross-section as seen in Table I and also in Table II. It is usually smallest for the wood of the swelled butt (unlike pine, where the stump is heavy) and is heaviest just above the swelled portion and then decreases but little in the main parts of the stem from below upwards (see Table II). The weight seems somewhat related to the rate of growth, the wood of fast-grown trees being generally lighter, but this relation is by no means constant. Every locality, every swamp and bottom has its light and its heavy wooded trees, and there is, as will be seen from Table II, no difference attributable to either locality or soil. The heaviest wood, comparing well with that of Longleaf Pine, is that of a Pond Cypress, growing in as poor soil as could be found and requiring over 400 years to produce a diameter of only 14 inches. Contrary to common belief, the White or Yellow Cypress from the Mississippi Valley is fully as heavy and strong as Cypress from more southern localities or from the Atlantic Coast.

The intimate relation between the weight of the wood and the proportion of summer wood has been alluded to as giving a ready means of distinguishing heavy and strong from light and weak timber.

The weight of the fresh wood is naturally even more variable than that of the dry wood, since here the matter is complicated by a very variable, but always large, amount of water. This water is about as abundant in the heart as in the sapwood, and varies from 70 to 200 per cent of the dry-wood substance. For this reason the green wood generally weighs over 50 pounds per cubic foot, and in heavy logs exceeds 60 pounds, and therefore can not be floated.

MOISTURE.

There is a general belief that Cypress dries only with difficulty and suffers considerably by kiln-drying, and also, what seems still more remarkable, that it "case-hardens" in kiln-drying, leaving under all circumstances a wet center. Experiments seem to show that Cypress, both in the open air at ordinary temperature and also if placed in the same kiln with sapwood of Loblolly Pine, parts with water at about the same rate as that wood—that is, dries as fast. Thus pieces 4 by 4 by 8 inches of fresh sapwood of Loblolly and pieces of heartwood of Cypress were placed side by side on the same shelf in an unheated shed and similar pieces were placed in the same part of the same dry-kiln, which was kept at a temperature of about 140° F.

The following sample case shows the result:

Time.	Loblolly drying—		Time.	Cypress drying—	
	At ordinary temperature.	In kiln.		At ordinary temperature.	In kiln.
Original weight ....grams..	1,682	2,284	Original weight ....grams..	2,327	2,304
Relative weight—			Relative weight—		
First day ....pounds..	100	100	First day ....pounds..	100	100
Tenth day ....do....	76	67	Tenth day ....do....	84	70
Twentieth day ....do....	68	52	Twentieth day ....do....	75	57
Thirtieth day ....do....	67	48	Thirtieth day ....do....	68	49

The above would seem to indicate that Cypress loses water as fast as sapwood of pine of about the same specific weight, and that the difference observed in practical drying in the yard and kiln is due to the great amount of water contained in the wood, especially the heartwood, which in Pine contains practically no liquid water at all, and also to the conditions under which drying is going on.

A series of experiments on 1-inch, 2-inch, and 3-inch material dried in an ordinary Cypress kiln in the usual way and involving 225 moisture determinations showed that all of the 1-inch and some of the 2-inch pieces were fairly dry, having been reduced to about 6 to 8 per cent moisture in the kiln, but that the interior parts of the 3-inch plank contained considerable quantities (up to 90 per cent) of moisture, thus clearly verifying the usual experience that kiln-dry Cypress is frequently not quite dry, being apt to contain a wet center; but the experiments also show that this does not appreciably hinder a further seasoning of this material.

It is evident that drying progresses more slowly in the exceedingly moist atmosphere of a good kiln running on Cypress, or the humid air within a pile of Cypress in the yard, than with Pine in corresponding places.

While these experiments show conclusively that the case has been exaggerated, the results do not prove the absence of any difference in this respect between Cypress and Pine, and further experiments are required to settle this very practical and important question.

The distribution of water with the length of the stick is usually much more uniform for green and partially dry material than the distribution across the section. Thus, in a piece of partly yard-dry material, only the ends were comparatively dry for the first 2 inches, but the rest of the 6-foot scantling varied only within about 15 per cent moisture, and the adjoining disks (2 inches thick) differed never by more than 3 per cent moisture. On the other hand, in the same scantling, a block one-half inch thick showed that in the same cross-section the center part had 109 per cent water, the corners only 16 to 22 per cent, and the parts between the corners 35 to 40 per cent, with the bottom one (side on which the scantling had rested) 128 per cent.

Cypress shrinks in proportion to its weight, and, standing intermediate in this latter respect between the heavy and light Pines, its shrinkage percentage is also intermediate. On the whole the shrinkage is about 8 to 10 per cent in volume. It is commonly greater in the heavier disks of any tree than in the lighter parts, as is well seen in comparing the light wood of butts of young trees with the heavier wood above the butt; it is generally greater in the wood of young trees than that of very old timber, and in all cases irregularities are observed which would indicate that other conditions not yet determined are also influential in this connection.

The following table presents the results of this inquiry for some of the trees from the principal localities. In this table Disk I, N. of tree 324, for instance, represents the wood of a part of the north half of Disk I, or the cross section of the tree 14 feet from the ground. The outer 20 rings are the piece next to the bark, and in this case have a specific weight of 0.42 when dry, of 0.90 when fresh. They contained 144 pounds of water with every 100 pounds of wood substance, and 100 cubic inches of this wood shrank 13 cubic inches, or 13 per cent. In most of the trees the disk pieces were split into 2-inch or 50 mm. pieces.

TABLE II.—*Weight, moisture, and shrinkage of Cypress from different localities.*

WHITE CYPRESS.

From the Savannah River Bottoms.

TREE No. 324.

[Age, over 240 years; height, 112 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
14	Entire I N.	47	81	96	12.1
	Outer 20 rings	42	90	144	13.0
	Next 20 rings	41	85	127	12.4
	Next 20 rings	47	68	66	13.7
	Next 20 rings	48	64	45	12.8
	Next 20 rings	47	67	62	11.0
	Next 20 rings	49	81	83	9.5
	Next 20 rings	51	97	118	12.4
	Next 20 rings	46	103	156	11.8
	Central piece	50	87	105	14.4

WHITE CYPRESS—Continued.

From the Savannah River Bottoms—Continued.

TREE No. 324—Continued.

[Age, over 240 years; height, 112 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
26	Entire II N.	46	72	75	11.0
	Outer 20 rings	44	62	60	11.8
	Next 20 rings	44	63	63	12.0
	Next 20 rings	45	58	47	12.0
	Next 20 rings	49	63	46	11.7
	Next 20 rings	47	77	84	10.3
	Next 20 rings	48	76	77	10.4
	Next 20 rings	50	99	120	10.2
	Next 20 rings	46	100	142	9.1

TABLE II.—*Weight, moisture, and shrinkage of Cypress from different localities*—Continued.

WHITE CYPRESS—Continued.

From the Savannah River Bottoms—Continued.

TREE NO. 324—Continued.

[Age, over 240 years; height, 112 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
45	Entire III N	48	77	82	11.0
	Outer 20 rings	46	81	99	11.2
	Next 20 rings	46	69	67	10.6
	Next 20 rings	46	58	41	11.4
	Next 20 rings	49	64	48	11.4
	Next 20 rings	49	82	86	10.0
	Next 20 rings	50	95	114	10.8
	Next 20 rings	50	93	112	11.2
	Central piece	47	89	148	15.7
57	Entire IV N	47	89	110	10.1
	Outer 20 rings	43	94	137	8.3
	Next 20 rings	45	92	128	10.8
	Next 20 rings	46	82	100	11.3
	Next 20 rings	49	67	52	10.0
	Next 20 rings	49	103	134	9.2
	Next 20 rings	50	87	96	10.5
	Central piece	46	90	118	10.0
69	Entire V N	50	90	101	10.0
	Outer 20 rings	47	93	117	10.3
	Next 20 rings	48	80	86	9.7
	Next 20 rings	49	76	73	9.7
	Next 20 rings	51	78	69	9.7
	Next 20 rings	51	106	127	9.0
	Next 20 rings	52	106	128	9.8
	Next 20 rings	51	90	102	13.5
81	Entire VI N	51	92	100	10.6
	Outer 20 rings	50	96	114	10.9
	Next 20 rings	53	93	100	11.8
	Next 20 rings	51	83	83	10.8
	Next 20 rings	50	85	86	8.9
	Next 20 rings	52	99	109	9.7
	Central piece	50	92	104	10.6

YELLOW OR WHITE CYPRESS.

From the Mississippi River Bottoms, Miss.

TREE NO. 355.

[Age, over 300 years; height, 124 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
7	Entire I N	47	74	72	9.0
	Outer 50 mm	50	78	75	9.6
	Next 50 mm	50	74	64	9.9
	Next 50 mm	49	62	39	8.0
	Next 50 mm	45	58	41	7.7
	Next 50 mm	43	89	128	9.1
	Central 100 mm	43	79	101	9.2
20	Entire II N	53	84	76	10.6
	Outer 50 mm	56	86	73	11.0
	Next 50 mm	55	70	41	9.2

YELLOW OR WHITE CYPRESS—Continued.

From the Mississippi River Bottoms, Miss.—Continued.

TREE NO. 355—Continued.

[Age, over 300 years; height, 124 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
20	Next 50 mm	51	85	86	10.2
	Next 50 mm	53	97	108	12.1
	Central 60 mm	40	94	161	11.7
26	Entire III N	52	89	87	8.8
	Outer 50 mm	52	93	100	9.9
	Next 50 mm	54	79	59	7.5
	Next 50 mm	54	92	83	7.5
	Next 50 mm	50	88	92	8.4
	Next 50 mm	54	95	100	10.6
	Central 36 mm	40	92	151	8.0
	Entire III S	55	92	76	10.6
	Outer 50 mm	58	93	82	12.0
	Next 50 mm	57	76	51	12.5
	Next 50 mm	49	103	134	10.1
	Central 32 mm	52	....	130	....
45	Entire IV N	53	79	62	7.7
	Outer 50 mm	50	78	71	9.4
	Next 50 mm	50	69	51	7.7
	Next 50 mm	57	93	75	6.5
	Next 50 mm	58	86	57	6.6
	Next 50 mm	54	80	60	7.9
	Central 50 mm	47	62	41	6.5
55	Entire V N	51	78	65	8.9
	Outer 50 mm	50	77	71	10.2
	Next 50 mm	54	86	74	8.3
	Central 100 mm	51	70	49	7.6
66	Entire VI N	50	77	69	8.6
	Outer 50 mm	48	81	85	9.2
	Next 50 mm	54	82	67	8.9
	Next 50 mm	51	73	53	8.5
	Central 69 mm	47	67	54	6.6
76	Entire VII S	52	77	64	9.4
	Outer 50 mm	48	77	79	9.6
	Next 50 mm	55	78	57	9.6
	Central 24 mm	53	75	53	8.6
87	Entire VIII N	51	82	75	9.4
	Outer 50 mm	49	82	85	9.7
	Central 77 mm	55	82	64	8.9
98	Entire IX N	50	84	85	9.6
	Outer 50 mm	49	86	93	9.6
	Next 50 mm	51	86	86	9.3
	Central 80 mm	53	75	58	10.5
	Entire limb pieces	55	80	68	13.3
	Limb disk I	56	85	65	9.5
	Limb disk II	53	85	78	10.6
	Limb disk III	53	62	61	8.1

TABLE II.—*Weight, moisture, and shrinkage of Cypress from different localities*—Continued.

POND CYPRESS.

From the Pine Barrens of South Carolina.

TREE NO. 277.

[Age, 425 years; height, 84 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
5	Entire I	60	106	99	10.3
	Outer 60 rings	49	97	122	11.2
	Next 60 rings	62	110	96	9.3
	Next 60 rings	63	110	94	9.7
	Central piece	64	108	89	11.0
18	Entire II	62	100	85	10.9
	Outer 60 rings	55	104	117	12.2
	Next 60 rings	66	113	90	9.6
	Next 60 rings	68	99	65	11.2
	Central piece	58	89	75	11.6
36	Entire III	57	104	103	10.5
	Outer 60 rings	48	104	139	9.7
	Next 60 rings	57	103	99	9.7
	Next 60 rings	61	109	98	9.7
	Next 60 rings	65	107	88	13.0
	Central piece	61	99	84	12.1
49	Entire IV	52	99	109	8.8
	Outer 60 rings	44	102	156	9.7
	Next 60 rings	55	104	105	8.1
	Central piece	55	94	86	8.6
59	Entire V	61	100	81	9.3
	Outer 60 rings	59	105	97	9.0
	Central piece	62	95	66	9.7
68	Entire VI	49	87	92	7.8

TREE NO. 280.

[Age c^a, 55 years; height, 48 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
0	Entire I	45	80	95	9.4
2	Entire II	53	97	101	9.8
6	Entire III	54	101	109	10.7
10	Entire IV	51	96	109	10.2
14	Entire V	50	94	108	10.8
18	Entire VI	48	91	108	10.0
22	Entire VII	47	90	112	9.7
26	Entire VIII	47	88	112	10.7
30	Entire IX	47	90	116	11.5
34	Entire X	46	87	119	13.1

TREE NO. 281.

[Age c^a, 55 years; height, 48 feet]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
0	Entire I	46	85	103	9.3
2	Entire II	57	101	99	10.5
6	Entire III	58	98	91	11.3
10	Entire IV	54	94	96	11.4
14	Entire V	52	96	105	10.6
18	Entire VI	52	92	99	11.2
22	Entire VII	54	95	99	11.8
26	Entire VIII	53	92	99	13.1
30	Entire IX	51	90	99	11.7
34	Entire X	48	92	109	9.6
38	Entire XI	49	85	99	13.7

WHITE CYPRESS.

From the Savannah River Bottoms, S. C.

TREE NO. 321.

[Age, c^a, 90 years; height, 112 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
4	Entire I N	37	58	79	10.0
	Outer 20 rings	37	58	75	11.0
	Next 20 rings	37	56	68	10.2
	Next 20 rings	34	59	90	8.7
	Central piece	45	57	76	......
	Entire I S	37	73	118	9.7
	Outer 20 rings	38	90	166	10.4
	Next 20 rings	37	65	95	9.8
	Next 20 rings	35	69	116	8.6
	Central piece	42	80	111	10.8
16	Entire II S	45	72	73	8.3
	Outer 20 rings	50	93	110	11.4
	Next 20 rings	46	74	99	7.5
	Next 20 rings	42	56	42	6.5
	Central piece	41	66	76	10.0
27	Entire III N	45	75	87	10.6
	Outer 20 rings	50	94	114	12.6
	Next 20 rings	45	81	98	10.0
	Central piece	41	57	51	8.9
	Entire III S	48	85	100	10.0
	Outer 20 rings	50	97	120	11.4
	Next 20 rings	49	90	102	9.7
	Central piece	45	75	83	9.1
47	Entire IV N	44	80	104	10.2
	Outer 20 rings	47	98	134	11.0
	Next 20 rings	43	81	110	10.2
	Central piece	40	57	58	9.2
	Entire IV S	44	75	89	10.3
	Outer 20 rings	46	90	118	9.6
	Next 20 rings	45	73	83	10.0
	Central piece	38	55	62	12.0
60	Entire V N	42	76	106	11.0
	Outer 20 rings	44	90	133	12.0
	Next 20 rings	39	70	100	10.1
	Central piece	41	54	38	......
	Entire V S	45	71	76	8.8
	Outer 20 rings	49	81	85	10.2
	Next 20 rings	43	65	93	8.6
	Central piece	39	70	85	3.6
71	Entire VI N	41	65	76	9.1
	Outer 20 rings	41	71	91	8.9
	Central piece	40	59	64	9.3
	Entire VI S	46	81	95	9.8
	Outer 20 rings	49	89	103	9.8
	Central piece	42	67	79	9.8
83	Entire VII N	41	87	132	9.5
	Outer 20 rings	39	90	150	9.0
	Central piece	49	76	76	11.6

TABLE II.—*Weight, moisture, and shrinkage of Cypress from different localities*—Continued.

WHITE CYPRESS—Continued.

From Savannah River Bottoms, S. C.—Continued.

TREE NO. 321—Continued.

[Age, cª, 90 years; height, 112 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
	Entire limb pieces	50	66	47	8.8
	Limb disk I	59	75	39	8.9
	Limb disk II	49	70	56	8.5
	Limb disk III	45	58	40	8.3
	Limb disk IV	47	66	56	9.9

"UPLAND" CYPRESS.

From Shaw, Bolivar County, Miss.

TREE NO. 456.

[Age, over 300 years; height, 151 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
10	Entire I N	47	81	99	12.4
	Outer 50 mm	44	102	162	12.5
	Next 50 mm	43	66	69	10.4
	Next 50 mm	49	58	36	13.1
	Next 50 mm	54	86	87	14.4
	Central piece	45	92	133	12.6
22	Entire II N	49	87	95	10.1
	Outer 50 mm	49	107	144	10.0
	Next 50 mm	49	70	53	7.2
	Next 50 mm	49	70	57	9.1
	Next 50 mm	57	91	87	14.8
	Central piece	44	102	172	13.9
41	Entire III N	48	89	103	9.0
	Outer 50 mm	46	98	133	9.2
	Next 50 mm	49	70	55	8.4
	Next 50 mm	51	91	98	9.0
	Central piece	48	102	139	9.8
51	Entire IV N	50	86	89	9.9
	Outer 50 mm	45	101	146	9.0
	Next 50 mm	55	74	52	11.8
	Next 50 mm	54	77	57	9.0
	Central piece	44	73	78	8.3
62	Entire V N	47	97	126	9.4
	Outer 50 mm	44	104	159	8.3
	Next 50 mm	51	102	118	8.9
	Next 50 mm	50	82	81	8.8
	Central piece	47	69	84	......
72	Entire VI N	48	82	86	8.5
	Outer 50 mm	45	94	126	8.8
	Next 50 mm	48	84	87	7.3
	Next 50 mm	51	69	45	7.7
	Central piece	48	58	34	9.3
83	Entire VII N	49	83	83	6.7
	Outer 50 mm	42	96	144	7.2
	Next 50 mm	50	88	87	5.7
	Next 50 mm	52	72	49	6.4
	Next 50 mm	50	67	43	6.8
	Central piece	59	77	44	7.0

"UPLAND" CYPRESS—Continued.

From Shaw, Bolivar County, Miss.—Continued.

TREE NO. 456—Continued.

[Age, over 300 years; height, 151 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
94	Entire IX N	49	95	113	7.6
	Outer 50 mm	45	102	146	8.5
	Next 50 mm	52	90	87	6.9
	Central piece	54	79	55	4.6
105	Entire X N	41	87	132	8.1

RED CYPRESS.

From Patterson, St. Marys Parish, La.

TREE NO. 348.

[Age, 145 years; height, over 48 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
2	Entire I	28	83	226	7.8
	Outer 50 mm	26	79	224	7.5
	Next 50 mm	29	94	242	8.4
	Central 32 mm	33	83	172	6.8
8	Entire II	42	84	121	9.4
14	Entire III	47	78	89	10.7
20	Entire IV	45	78	90	9.5
26	Entire V	46	80	93	9.8
32	Entire VI	44	72	81	8.9
38	Entire VII	50	79	77	10.8
44	Entire VIII	......	75	......	......
50	Entire IX	46	74	86	12.5

TREE NO. 346.

[Age cª, 165 years; height, 81 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
5	Entire I	44	88	119	10.2
	Outer 50 mm	41	77	104	6.7
	Next 50 mm	48	98	124	8.6
	Next 50 mm	47	100	142	12.6
	Central 50 mm	44	75	115	18.4
17	Entire II	51	81	76	9.8
28	Entire III	52	88	88	10.4
38	Entire IV	49	76	74	10.2
48	Entire V	49	75	69	10.2
59	Entire VI	50	72	62	10.2

TREE NO. 347.

[Age, 135 years; height, 42 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
2	Entire I	30	80	194	7.7
8	Entire II	40	78	116	9.1
14	Entire III	43	77	95	9.0
20	Entire IV	40	64	75	8.0
26	Entire V	39	58	62	8.3
32	Entire VI	40	59	61	8.2

TABLE II.—*Weight, moisture, and shrinkage of Cypress from different localities*—Continued.

YELLOW OR WHITE CYPRESS.

From the Mississippi River bottoms, Mississippi.

TREE NO. 354.

[Age ca., 300 years; height, 124 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
10	Entire I N	41	64	68	8.6
	Outer 50 mm	39	54	50	8.1
	Next 50 mm	42	50	31	9.0
	Next 50 mm	43	65	70	9.8
	Next 50 mm	45	94	133	9.8
	Next 50 mm	44	78	95	8.4
	Next 50 mm	39	51	42	7.2
	Central 65 mm	35	56	69	6.2
	Entire I S	41	58	55	8.8
	Outer 50 mm	40	65	78	8.5
	Next 50 mm	40	50	32	7.8
	Next 50 mm	41	51	36	7.7
	Next 50 mm	42	58	51	10.1
	Next 50 mm	42	69	84	10.2
	Central 72 mm	40	57	56	7.9
22	Entire II S	49	62	64	7.4
	Outer 50 mm	54	79	59	6.8
	Next 50 mm	50	67	45	7.4
	Next 50 mm	48	83	87	7.7
	Next 50 mm	49	78	72	7.7
	Next 50 mm	43	69	74	9.0
	Central 54 mm	37	62	80	5.1
41	Entire III S	46	70	70	10.1
	Outer 50 mm	45	76	84	9.3
	Next 50 mm	47	57	35	9.9
	Next 50 mm	47	67	61	11.0
	Next 50 mm	49	92	115	12.0
	Central 80 mm	40	63	71	8.5
51	Entire IV S	45	81	95	7.8
	Outer 50 mm	47	76	75	7.5
	Next 50 mm	45	72	74	8.1
	Next 50 mm	43	93	134	7.8
	Central 47 mm	46	93	122	7.5
61	Entire V N	47	68	62	10.4
	Outer 50 mm	47	68	60	10.0
	Next 50 mm	48	61	42	10.5
	Next 50 mm	49	66	50	10.0
	Next 50 mm	47	77	87	12.6
	Central 79 mm	37	75	122	8.6

RED CYPRESS.

From St. Marys Parish, La.

TREE NO. 344.

[Age ca., 150 years; height, 119 feet.]

Height from ground (feet).	Portion of disk or cross-section.	Specific gravity, × 100. Dry.	Specific gravity, × 100. Green.	Amount of water in green wood with every 100 pounds of wood substance.	Shrinkage, per cent.
7	Entire I N	45	79	102	12.4
	Outer 50 mm	42	103	181	13.5
	Next 50 mm	45	66	68	12.7
	Next 50 mm	46	68	66	11.2
	Next 50 mm	47	70	71	12.3
	Central 88 mm	45	76	91	11.9
	Entire I S	46	82	94	9.0
	Outer 50 mm	47	104	142	8.4
	Next 50 mm	46	71	68	9.0
	Next 50 mm	46	74	75	8.3
	Next 50 mm	49	73	65	9.6
	Next 50 mm	45	74	82	10.5
	Central 70 mm	43	81	109	10.1
19	Entire II N	44	80	107	12.1
	Outer 50 mm	42	103	180	11.9
	Next 50 mm	44	61	58	12.0
	Next 50 mm	46	72	79	12.7
	Next 50 mm	47	74	77	11.7
	Central 70 mm	44	80	110	12.6
	Entire II S	45	78	97	11.7
	Outer 50 mm	43	75	96	11.3
	Next 50 mm	47	66	59	11.3
	Next 50 mm	46	67	63	10.2
	Next 50 mm	47	85	111	14.4
	Central 52 mm	42	75	106	13.3
32	Entire III N	44	91	133	10.5
	Outer 50 mm	40	107	196	10.3
	Outer 50 mm	45	81	103	12.2
	Outer 50 mm	46	79	93	10.5
	Outer 50 mm	47	89	105	7.2
	Central 53 mm	42	82	119	10.4
	Entire III S	44	81	108	11.1
	Outer 50 mm	42	103	175	11.4
	Next 50 mm	46	75	85	11.1
	Next 50 mm	45	72	80	10.9
	Next 50 mm	44	65	65	11.1
	Central 70 mm	41	74	103	11.0

MECHANICAL PROPERTIES.

The strength of Cypress, like its weight, is intermediate between that of the heavy and light pines. The tests indicate an average strength of dry wood (12 per cent moisture) in—

	Pounds per square inch.
Compression endwise and bending to true elastic limit*	6,400
Bending to relative elastic limit †	6,800
Bending to rupture	8,100
Modulus of elasticity	1,300,000
Shearing	500

Since the wood was tested at varying percentages of moisture, the values required reduction to correspond to some uniform moisture percentage, and therefore still contain a slight element of uncertainty, which, however, in ordinary application, need not be considered.

In the following table of tree averages the results are grouped by localities, and the tests on large and small sizes kept separate.

It is necessary to add a word of caution regarding the interpretation of these results. Since the great difficulty of obtaining specimens of Cypress in the manner desired for these investigations necessarily and seriously limited the number collected at each point, the figures of this table, though fairly representing the range of strength of this species in general, can not be regarded as sufficient to develop properly the influence of locality. Thus, it would be entirely unwarranted to suppose that Louisiana Cypress is weaker than the Yellow Cypress from farther up the river, though the figures are believed to be amply sufficient to warrant the negative statement—that the common belief or claim of greater softness and lightness of this up-river Cypress is unfounded. It was the intention to amplify these results by tests of a larger quantity of material obtained at points of manufacture, and until such a series is undertaken the matter must remain quantitatively doubtful. Nevertheless, the results recorded in Table III, and still more so those in Table IV, show that individual variations and variations within one and the same tree are fully as great as the differences brought out for the wood from different localities.

TABLE III.—*Strength of cypress (at 12 per cent moisture).*

TREE AVERAGES.

[NOTE.—Figures in bold-faced type refer to tests on large beams.]

Tree No.	Locality.			Approximate age (years).	Number of sticks tested.	Specific gravity of dry wood × 100.	Cross bending: Dimensions (inches). *l.*	*h.*	*b.*	Modulus of strength at— Relative elastic limit. (Pounds per square inch.)	Rupture. (Pounds per square inch.)	Modulus of elasticity in 1,000 pound units.	Compression: Endwise. (Pounds per square inch.)	Across grain, 3 per cent distortion. (Pounds per square inch.)	Shearing. (Pounds per square inch.)
274	Pond Cypress, Hampton Co.	South Carolina.	Atlantic coast.	325	65	42	70	3	3	5,990	7,030	1,075	5,520	850	405
275				300	22	51	70	3	3	6,490	7,540	1,173	6,270	940	460
276				315	22	45	70	3	3	6,510	7,390	1,281	6,220	890	420
277				425	45	58	70	3	3	7,670	8,480	1,774	7,740	870	410
278				270	24	55	70	3	3	6,920	8,120	1,355	6,510	910	520
279				105	7	50	70	3	3	6,720	8,290	1,515	5,950	900	500
321	Savannah River bottom.			90	7	43	70	3	3	5,000	6,240	892	5,470	840	560
					1		**132**	**15**	**8**	**6,110**	**6,240**	**886**			
322				90	21	39	70	3	3	4,900	5,750	841	5,200	700	490
					3		**132**	**15**	**8**	**7,920**	**8,960**	**999**			
323				85	25	47	50	3	3	7,230	8,880	1,163	6,890	870	560
					2		**132**	**15**	**8**	**7,820**	**9,060**	**1,215**			
324				240	20	48	60	3	3	7,760	9,350	1,275	7,170	730	430
					2		**132**	**15**	**8**	**8,420**	**8,370**	**1,325**			
Average of trees from Atlantic coast					258	48				6,520	7,710	1,234	6,290	850	480

* To be used for f in the beam formula: $f_1 = \frac{3 W_1 l}{2 b d^2}$.

† For explanation of the "relative" elastic limit, see Bulletin 6 of this Division.

TABLE III.—*Strength of cypress (at 12 per cent moisture)*—Continued.

TREE AVERAGES—Continued.

[NOTE.—Figures in bold-faced type refer to tests on large beams.]

Tree No.	Locality.			Approximate age (years).	Number of sticks tested.	Specific gravity of dry wood × 100.	Cross bending. Dimensions (inches). *l.*	*h.*	*b.*	Modulus of strength at— Relative elastic limit. (Pounds per square inch.)	Rupture. (Pounds per square inch.)	Modulus of elasticity in 1,000 pound units.	Compression. Endwise. (Pounds per square inch.)	Compression. Across grain, 3 per cent distortion. (Pounds per square inch.)	Shearing. (Pounds per square inch.)
343	St. Mary's Parish.	Louisiana.	Gulf region.	90	128	37	70	3	3	5,120	6,210	996	4,770	680	460
					1		**144**	**12**	**8**	**5,020**	**5,100**	**1,007**			
344				150	41	45	70	3	3	6,550	8,180	1,406	6,070	830	480
					1		**144**	**12**	**8**	**6,420**	**6,360**	**1,246**			
345				190	63	35	70	3	3	5,000	6,250	925	4,600	640	430
					1		**144**	**12**	**8**	**6,530**	**6,480**	**1,074**			
346				165	8	50	70	3	3	6,470	8,160	1,173	6,100	880	640
353	Pantherburn, Washington Co.	Mississippi.		300	37	43	70	3	3	7,680	9,270	1,500	6,840	760	450
					1		**210**	**12**	**8**	**9,590**	**10,310**	**1,640**			
354				300	51	46	70	3	3	8,730	10,370	1,768	7,290	780	460
					1		**216**	**12**	**8**	**6,610**	**6,610**	**1,478**			
355				315	33	52	70	3	3	9,000	11,350	1,734	7,860	880	530
					1		**210**	**12**	**8**	**8,850**	**10,190**	**1,762**			
455	Shaw, Bolivar Co.			335	24	44	70	3	3	7,710	8,900	1,660	6,760	670	450
					2		**194**	**15**	**7**	**5,720**	**6,560**	**1,474**			
457				335	12	49	70	3	3	8,380	9,710	1,786	7,660	720	450
					1		**138**	**13**	**8**	**8,120**	**8,630**	**1,725**			
Average of trees from gulf region					397	45				7,180	8,710	1,439	6,440	760	480
Average of all trees tested	Small pieces.				655	47	68	3	3	6,830	8,180	1,326	6,360	810	480
	Large pieces.				**17**		**160**	**13**	**8**	**7,260**	**7,740**	**1,319**			

A careful survey of the field, following months of detailed laboratory investigation of this material, fully convinced the writer that the great differences frequently claimed for Cypress from different localities will not be substantiated by further tests, but that, on the contrary, a proper series of tests will prove Cypress from any and every locality to be one of the most uniform woods in our market, with strength values for the bulk of Cypress lumber differing but little from the average as stated above.

Such a table of averages has only a limited value, since the data entering into the average are heterogeneous, and their relative character is not considered.

RANGE OF STRENGTH.

The range of strength displayed is illustrated in the following table, where the values of strength of dry wood (12 per cent moisture) for brevity and perspicuity are grouped, the table giving for each tree the number of tests falling between certain range limits. That is to say, in tree 354, for instance, there were two tests in bending to relative elastic limit which gave values for extreme fiber stress between 6,500 and 7,000 pounds per square inch; eight tests gave values of 7,000 to 7,500 pounds; seven tests gave values between 7,500 and 8,000 pounds, etc.

This table gives in a convenient form a detailed account of all results, and at the same time indicates the total and relative range of strength. As a rule, it is safe to assert that isolated extreme values on the weak or upper end of each set of figures refer to defective material which would not have been tested had the defect been noticed in time, while extremes at the other end refer to select or perfect pieces, where the grain of the wood was satisfactorily straight. The range is, on the whole, comparatively small for all tests, as is well illustrated in tree 274 and still more in 343 and 345, and the conspicuous deviation in cases like 277 and 353 are due largely to a pronounced development of "alternating" oblique grain, a peculiarity very commonly met in Cypress.

TABLE IV.—*Range of strength of Cypress in compression endwise, bending at relative elastic limit and rupture, and of modulus of elasticity.*

TEST RESULTS REDUCED TO 12 PER CENT MOISTURE (SHED DRY).

Ranges in 100 pounds per square inch.	Tree No. 354.		Tree No. 355.		Tree No. 277.		Tree No. 455.		Tree No. 457.	
	Specific gravity of dry wood × 100.									
	46.		52.		58.		44.		49.	
	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.
	Number of tests.									
40– 45					1					
45– 50					2		2			
50– 55					2			1		
55– 60				1	2		1	2		
60– 65		2		1	4	3	1	5		
65– 70	2	13	1	3	6	4	2	8	1	1
70– 75	8	14	2	6	3	12	4	2	1	4
75– 80	7	5	3	7	2	6	6	2	3	6
80– 85	6	6	4	5	8	9	7	1	3	
85– 90	10	2	8	6	4	10	1	1	1	
90– 95	8		1		4		2		2	
95–100	6		4	2	6	1			2	1
100–105	1		4		1					
105–110	1		1							
110–115	1		1							
115–120	1		4							
120–125	1									
Average strength in pounds per square inch	7,670	7,740	8,730	7,290	9,000	7,860	7,710	6,760	8,380	7,660
Ranges for modulus at rupture in 100 pounds per square inch, for modulus of elasticity in 10,000-pound units.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity
50– 55					1		1			
55– 60					4					
60– 65					1		1			
65– 70					5					
70– 75					3					
75– 80					3		3		1	
80– 85	1				2		6		1	
85– 90	4				1		3		2	
90– 95	6		2		6		5		3	
95–100	8		4		6		3		1	
100–105	9		4		5		3		2	
105–110	9		1		5		1			
110–115	6		4		2	1			2	
115–120	3		5						1	
120–125	1		4			1		1		
125–130	1		1			2		2		
130–135			4			2		1		
135–140			2	4				1		
140–145		1		2		1		1		1
145–150		3	1			1		2		1
150–155		1		3		3		1		
155–160		1		2		1				
160–165		4		7		5		1		1
165–170		7		3		1		4		1
170–175		9				6		4		2
175–180		4		1		2		2		
180–185		11		1		2		1		1
185–190		2		1				3		1
190–195		1		1		3		1		2
195–200		4								3
200–205		2		2		1				
205–210				3		4				
210–215						3				
215–220				2		2				
220–225						2				
Average {pounds per square inch	10,370		11,350		8,480		8,900		9,710	
Average {1,000-pound units		1,768		1,734		1,774		1,660		1,786

TABLE IV.—*Range of strength of Cypress in compression endwise, bending at relative elastic limit and rupture, and of modulus of elasticity*—Continued.

TEST RESULTS REDUCED TO 12 PER CENT MOISTURE (SHED DRY)—Continued.

Ranges in 100 pounds per square inch.	Tree No. 278.		Tree No. 323.		Tree No. 324.		Tree No. 344.		Tree No. 353.	
	Specific gravity of dry wood × 100.									
	55.		47.		48.		45.		43.	
	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.
	Number of tests.									
40- 45			1				1			
45- 50			1				1			
50- 55			2	1	1	1	2	3		
55- 60	5	6	3	2		1	5	16	1	4
60- 65	2	7	3	7	1	2	6	9	2	11
65- 70	5	7	2	14	1	2	18	8	6	7
70- 75	5	3	3	6	3	2	5	4	6	5
75- 80	4		2	3	2	3	3		6	5
80- 85	3		4	1	5	4	1		5	2
85- 90			2	1	6				3	
90- 95			1		1				3	
95-100			1	1					1	1
100-105			1		1				2	
105-110			1							
110-115									1	
Average strength in pounds per square inch	6,920	6,510	7,230	6,890	7,770	7,170	6,550	6,070	7,680	6,840

Ranges for modulus at rupture in 100 pounds per square inch, for modulus of elasticity in 10,000-pound units.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.
50- 55	1		1							
55- 60	3						1			
60- 65			4				1			
65- 70			2				4			
70- 75	4		1				2		2	2
75- 80	2				1		6		2	2
80- 85	3		5		5		16		5	5
85- 90	4		2		2		7	2	8	8
90- 95	4	1	2	3	3		2		7	7
95-100	2		1		4		2		3	4
100-105	1		5	1	2	1	1	1	6	6
105-110				3	3			2	3	3
110-115		3		3	1	2		2	1	2
115-120		3	1	1		1		3		2
120-125		1	1	1		1		4		1
125-130		1		2		2		1		2
130-135		1	1	2		3		3		2
135-140		2	1	1		1		2		5
140-145		1				2		3		3
145-150		2		3		1		2		2
150-155		3		1				2		4
155-160		2		1		1		3		3
160-165								3		6
165-170		2		1				4		2
170-175		1				3		3		1
175-180						1		1		1
180-185								1		1
Average { pounds per square inch	8,120		8,880		9,350		8,180		9,270	
Average { 1,000-pound units		1,355		1,163		1,275		1,406		1,500

TABLE IV.—*Range of strength of Cypress in compression endwise, bending at relative elastic limit and rupture, and of modulus of elasticity*—Continued.

TEST RESULTS REDUCED TO 12 PER CENT MOISTURE (SHED DRY)—Continued.

Ranges in 100 pounds per square inch.	Tree No. 274.		Tree No. 275.		Tree No. 276.		Tree No. 279.		Tree No. 346.	
	Specific gravity of dry wood × 100.									
	42.		51.		45.		50.		50.	
	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.
	Number of tests.									
40–45	1									
45–50	3	10								2
50–55	13	22	2	3	1	2		1	1	
55–60	14	24	4	6	6	3	2	2		1
60–65	21	7	5	5	3	11	1	3	4	1
65–70	10	1	4	5	7	5	2	1	1	4
70–75	2		6	2	3	1			1	
75–80		1	1	1	2		2		1	
80–85	1								1	
Average strength in pounds per square inch	5,990	5,520	6,490	6,270	6,510	6,220	6,720	5,950	6,470	6,100

Ranges for modulus at rupture in 100 pounds per square inch, for modulus of elasticity in 10,000-pound units.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.
45– 50	1									
50– 55			1		1					
55– 60	3				3					
60– 65	10		1							
65– 70	16	3	3		3				2	
70– 75	18		5		2		1			
75– 80	11	6	4	1	6		3		2	
80– 85	6	4	4		4		1		1	1
85– 90		5	3	1	2					
90– 95			1	3	1	1	1		3	
95–100		2		2			1	1		1
100–105		6		1						
105–110		7		1		2				
110–115		3		2		1				
115–120		5				4				1
120–125		12		1		3		1		3
125–130		4		1				2		
130–135		6		2		2		1		
135–140		1		3		4				1
140–145		1		3		1				1
145–150				1		2		1		
150–155						1				
Average: Pounds per square inch	7,030		7,540		7,390		8,290		8,160	
Average: 1,000-pound units		1,075		1,173		1,281		1,515		1,173

TABLE IV.—*Range of strength of Cypress in compression endwise, bending at relative elastic limit and rupture, and of modulus of elasticity*—Continued.

TEST RESULTS REDUCED TO 12 PER CENT MOISTURE (SHED DRY)—Continued.

Ranges in 100 pounds per square inch.	Tree No. 343.		Tree No. 345.		Tree No 321.		Tree No. 422.	
	Specific gravity of dry wood × 100.							
	37.		35.		43.		39.	
	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.	Bending to relative elastic limit.	Compression endwise.
	Number of tests.							
Less than 35	9	6	....	2	....	....	2	1
40–45	10	31	8	26	1	....	3	1
45–50	26	63	30	26	1	1	3	3
50–55	51	19	14	5	2	2	6	9
55–60	28	7	7	2	....	3	1	2
60–65	4	1	2	1	2	1	2	4
65–70	1	....	3	....	1	....	2	....
70–75	....	....	....	....	....	....	....	....
75–80	....	....	....	....	....	....	1	....
80–85	....	....	....	....	....	....	2	....
Average strength in pounds per square inch	5,120	4,770	6,550	6,070	5,000	5,470	4,900	5,200

Ranges for modulus of elasticity in 10.000-pound units for modulus at rupture in 100 pounds per square inch.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.	Bending to rupture.	Modulus of elasticity.
Less then 35	2	....	....	....	....	....	....	....
40– 45	2	....	....	....	1	....	1	....
45– 50	6	....	....	....	1	....	3	2
50– 55	15	....	6	....	....	....	2	....
55– 60	18	....	11	....	....	....	1	2
60– 65	32	2	26	....	2	....	3	....
65– 70	38	....	11	....	2	1	7	....
70– 75	10	1	7	3	1	....	2	2
75– 80	3	2	1	2	....	1	....	3
80– 85	2	10	1	16	1	2	....	1
85– 90	....	7	....	13	....	1	2	4
90– 95	....	14	....	11	....	1	1	2
95–100	....	22	....	2	....	....	....	5
100–105	....	23	....	6	....	....	....	....
105–110	....	20	....	4	....	....	....	1
110–115	....	15	....	1	....	....	....	....
115–120	....	11	....	3	....	....	....	....
120–125	....	....	....	1	....	....	....	....
125–130	....	....	....	2	....	....	....	....
Average: Pounds per square inch	6,210	....	6,250	....	6,240	....	5,750	....
Average: 1,000-pound units	....	996	....	925	....	892	....	841

NOTE.—Trees Nos. 274 to 279 = Pond Cypress from Hampton County, S. C.; Nos. 321 to 324 = White Cypress from Savannah River bottoms, South Carolina; Nos. 343 to 346 = Red Cypress from St. Marys Parish, La.; Nos. 353 to 355 = Yellow or White Cypress from Pantherburn, Washington County, Miss.; Nos. 455 to 457 = Upland Cypress from Shaw, Bolivar County, Miss.

Heavy Cypress is stronger than lighter timber, and there is an evident close relation between weight and strength in compression as well as strength in cross bending, as is shown by the following table, in which the number of tests on green wood which fell within the given ranges of strength (1,000 pounds differences) in each tree are given:

TABLE V.—*Relation of strength of green Cypress in compression endwise to specific weight of the dry wood.*

No. of tree.	Specific weight of dry wood.	Pounds per square inch. 2,000 to 2,900.	3,000 to 3,900.	4,000 to 4,900.	5,000 to 5,900.	6,000 to 6,900.	7,000 to 7,900.	8,000 to 8,900.	Average strength in pounds per square inch.
		Number of tests falling within given ranges of strength.							
277	0.58				7	13	5	1	6,500
278	.54			10	9				4,800
275	.50		2	11	5				4,700
344	.44		2	19					4,200
274	.41		32	23					3,800
343	.37	7	43						3,200
345	.35	17	13						2,900

TABLE VI.—*Relation of cross-breaking strength of green Cypress to specific weight of the dry wood.*

No. of tree.	Specific weight of wood.	Pounds per square inch. Less than 5,000.	5,000 to 5,900.	6,000 to 6,900.	7,000 to 7,900.	8,000 to 8,900.	9,000 to 9,900.	Average bending strength. At relative elastic limit.	At rupture.
		Number of tests falling within given ranges of strength.							
277	0.58		5	5	6	12	8	6,800	7,800
278	.54		3	5	9	4		5,600	7,100
275	.50	1	7	6	5			5,000	6,300
274	.41	7	32	20	2			4,500	5,800
343	.37	20	35	2	1	1		3,800	5,100
345	.35	18	15					3,600	5,000

It may be argued that the trees in the preceding table have been especially selected, and that the relation as shown above is more a matter of coincidence than of cause and effect. The selection is admitted, but was made only because these were the only trees for which a sufficient number (20 or more) of green tests were made. Moreover, the same relation for dry wood, though slightly obscured through the uncertain factor of moisture, is quite apparent from Table IV, where it will be seen that, for instance, the trees Nos. 322, 343, and 345 with their low specific weight also display the least resistance, while 277 with its heaviest wood, in spite of some cross grain, is also the strongest and stiffest timber tested.

From what has been said with respect to weight and its relation to strength, it is clear that as all localities have their heavy and their light timber so they all share in strong and weak, hard and soft material, and the difference in quality of material is evidently far more a matter of individual variation than of soil or climate.

The emphatic claim recently made by European writers, that good soil and heavy timber universally go together, has never been so perfectly contradicted as by these experiments, which show that some of the Pond Cypress from South Carolina (tree 277), grown on the very poorest soil and requiring four centuries to barely make a telegraph pole, is both the heaviest and strongest material of the collection, and is fully as heavy as any found during a visit to all the larger cypress mills.

The great uniformity in the strength of select Cypress is well illustrated by the series of experiments made on the maximum uniformity of wood, and in part recorded in circular 18 of this series, which show that as far as weight and strength are concerned Cypress is one of the most uniform woods obtainable for detail studies into the behavior of wood and the relations of its several properties. In this study select scantlings 2 by 2 in cross section of perfectly quarter-sawed Cypress were cut seriatim into blocks $2\frac{3}{4}$ inches high and all the blocks tested in compression while perfectly fresh. From 100 tests in compression endwise it appeared that the average strength of the three scantlings was 4,090 pounds for the first, 3,120 pounds for the second, and

4,330 for the third; that the greatest difference in strength of any two contiguous blocks was 70 pounds, or 1.8 per cent; but it also showed the very important fact, which should be noted by all who are called upon to test wood, that even in a 6-foot scantling of such exceedingly uniform material as Cypress the two ends may sometimes differ from each other in their strength by from 5 to 30 per cent, a fact well calculated to teach caution and point out the necessity of detail study on small-size material if the true behavior of wood is to be ascertained. A similar series of tests on wood which had first been yard dried and then soaked for several months indicates that soaked wood generally behaves like green wood.

Table VII presents these relations in detail:

Table VII.—*Maximum uniformity in compression endwise of contiguous blocks of green and soaked Cypress.*

[Dimensions of blocks 2 by 2 inches and 2¾ inches high. Compression strength in pounds per square inch.]

Number of block.	Number of scantling.			
	I.	II.	III.	IV.
	Green.			Soaked three months.
1	2,720	4,170	4,260	3,170
2	2,700	4,190	4,310	3,020
3	2,720	4,170	4,380	2,890
4	2,680	4,180	4,330	2,900
5	2,680	4,200	4,290	2,910
6	2,720	4,180	4,310	2,860
7	2,770	4,230	4,290	2,900
8	2,820	....	4,220	2,950
9	2,870	....	4,270	....
10	....	....	....	2,860
11	3,020	4,230	4,340	2,860
12	3,070	4,180	4,320	2,980
13	3,090	4,130	4,320	2,970
14	3,120	4,160	4,300	3,010
15	3,170	4,160	4,360	3,000
16	3,140	4,160	4,300	3,060
17	3,090	4,110	4,270	3,060
18	....	4,099	4,270	3,070
19	3,120	4,070	4,340	3,080
20	....	....	....	3,130
21	3,170	3,990	4,300	3,190
22	3,220	4,060	4,300	3,250
23	3,270	4,040	4,340	....
24	3,320	4,060	4,390	....
25	3,370	4,080	4,410	....
26	....	4,080	4,390	....
27	3,320	4,040	4,390	....
28	3,370	4,040	4,390	....
29	3,420	3,990	4,360	....
30	....	....		
31	3,490	3,970	4,360	....
32	3,520	3,910	4,390	....
33	3,570	3,890	4,360	....
34	3,620	3,840	4,320	....
35	3,640	....	....	....
Average strength	3,120	4,090	4,330	3,006
Greatest difference between adjacent blocks	50 lbs.=1.4%	70 lbs.=1.7%	70 lbs.=1.6%	150 lbs.=4.8%
Range of strength	960 lbs.=31%	390 lbs.=10%	190 lbs.=5%	390 lbs.=12%

The influence of moisture on strength is evident from the fact that in the general series of experiments over 50 per cent was added to the compression strength by drying to 12 per cent. It is still more clearly pointed out by the few special experiments made on select material, where the strength in compression was raised from about 3,000 to 6,500, or was more than doubled by complete drying to below 2 per cent moisture.

DURABILITY.

One of the most highly valued properties of Cypress is its great durability. Rived shingles of Cypress are claimed to have endured over eighty years in Philadelphia and Baltimore. Posts and piling of Cypress are sought for their durability. Cypress excels for tank material, and of late builders of greenhouses, with whom a Hemlock or Oak board decays in one to three years, are beginning to use Cypress for frames and partitions. In the woods old Cypress logs endure apparently for centuries, and, as with Cedar, a great deal of good shingle timber has been dug out of the ground apparently as sound as ever and certainly as much appreciated for this purpose as logs of standing trees. This durability is restricted naturally to the heartwood, the sap decaying readily, as with other woods. Occasionally cases are reported where Cypress has failed and led to disappointment for want of durability. This is true also of other durable woods, such as Red and White Cedar, and while in some cases the matter may be one of mistake in observation, it is most likely that conditions arise where even durable timber fails to be durable. At all events it is necessary to keep in mind that to day our knowledge as regards the durability of woods is entirely a matter of empirics. The experience of

practical men in their actual use, which, although valuable, always fails in reliability for two reasons: the conditions are complex and not all observed and the observations are unsystematic and merely matters of incident. This deplorable ignorance concerning the durability of our timber perpetuates prejudice and prevents giving more than indefinite information on this point. On railways, where the wear causes often as much injury to the soft Cypress ties as decay, the life of Cypress is reported as eight to ten years against five to seven for Pine and Hemlock and six to eight years for White Oak, which latter have the advantage of greater mechanical resistance. In general it is probably safe to say that the heartwood of Cypress lasts two to three times as long as the heartwood of Pine.

SUMMARY.

Compared with other timber the position of Cypress as a material is about as follows: It is as cheap as good soft Pine; dearer per foot than hard Pine; can be had in large dimensions as free of knots and defects as any timber in the eastern United States. In its weight it is on the border between heavy and light pines and occupies the same position as to its strength, while in many cases its durability insures its preference. Cypress is a pretty wood, often truly beautiful; works easily; shrinks no more than other conifers of the same weight; if properly seasoned, stands just as well as any of them after manufacture, and readily takes paint and good polish. The supply of Cypress is considerable and the output is capable of material increase, but once gone, the present forests will be unable to replace the supplies, and it is doubtful whether Cypress can be thought of as a timber of the future.